PATENTS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Linghsiao WANG

Group Art Unit: 2151

Application No. 10/729,804

Examiner G. Madamba

Filed: December 5, 2003

For: CLASS-BASED RATE CONTROL USING A MULTI-THRESHOLD LEAKY BUCKET

RESPONSE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Office Action mailed July 9, 2007, applicant respectfully requests reconsideration of the rejection of claims 1-27.

The Examiner has rejected claims 1-27 under 25 U.S.C. §103(a) as being unpatentable over U.S. Publication 2003/0035374 by Carter in view of U.S. Patent 7,126,913 issued to Patel.

The claims of the present application are directed to apparatus and methods for effecting rate control of egress traffic from an edge network node and of ingress traffic to an edge network node. A leaky bucket is used having multiple threshold level registers. Broadly, when a packet is received, a traffic class of the packet is checked, and a determination on whether to suppress transmission (in the case of egress traffic) is made based on the traffic class of the packet and on the occupancy of the leaky bucket as indicated by the multiple threshold level registers and by a current token availability of the bucket. A similar decision is made for ingress traffic using similar considerations, namely the traffic class of the packet and the occupancy of the leaky bucket as indicated by the current token availability and the multiple threshold level registers, except that a probability discard register associated with each traffic class is also considered, and that the packets are discarded rather than suppressed. The claimed invention allows a single

leaky bucket to be used for traffic of multiple traffic classes, while preferentially allowing traffic of certain classes to be transmitted when resources are limited.

Carter is directed to a method of reducing traffic congestion between routers by determining a statistical bit rate over sequential intervals. Based on the sampling of actual bit rates and a statistical estimation of projected congestion, the output bit rate of a buffer is adjusted. Carter discusses leaky buckets only twice, towards the very end of the description of the method (paragraphs 84 and 86), and only in very general terms. The objective of Carter is clearly not to provide a leaky bucket routine for managing traffic flow rates.

Patel is directed to a method of managing transmission resources at a node, and in particular for determining whether to transmit packets through a node based on other traffic and available resources. Patel teaches a method of using leaky buckets to achieve this, including a new type of leaky bucket and a new way of defining tokens to be used in relation to the bucket. The bucket and the tokens are multi-dimensional. As the simplest example (Figures 3 to 8e) the token for a packet is two dimensional, with one dimension indicating the time resources required for transmitting a packet and with one dimension indicating the power resources required for transmitting a packet (Figures 5, 8a). The bucket is also two dimensional (Figure 4). When a packet is to be transmitted, the method determines whether there is sufficient two dimensional token-space within the bucket to accommodate the packet (Figures 8b-8e; element 114 of Figure 7 and description at column 9 lines 14-23). Patel also provides an example of three dimensional tokens and buckets, in which geographic information (sectors and interference) is used as the third dimension. However, nowhere does Patel teach the use of traffic class in a determination of whether there are sufficient resources to transmit a packet, and certainly does not teach the use of a single bucket with multiple threshold level registers for determining whether to transmit a packet based on the traffic class of the packet and on the current occupancy of the bucket as indicated by the multiple threshold registers. In fact, Patel strongly suggests the use of multiple buckets in order to handle packets of different traffic classes: "To support multiple service levels, multi-media, and customer groups, packet flows in the mobile gateway 20 may be organized into a plurality of discrete groups. In this case, a separate set of multiple dimension token buckets 44 may be used to police and control flows in each group." (column 7 lines 10-14).

Neither Carter nor Patel teach or suggest the present claimed invention. The differences between the present claims and the teachings of Carter and Patel will be seen more clearly by considering the specific elements of the present claims.

Claim 1 is directed to an egress rate controller which includes a packet transmission suppression controller. The packet transmission suppression controller selectively suppresses transmission of a packet based on a current token availability level being within a token availability region specifying transmission suppression of packets of the traffic class of the packet. This is a feature not taught or suggested by either Carter or Patel. The Examiner has cited extensively from Patel as teaching this feature. However, nowhere does Patel teach or suggest this feature. Figures 3 and 4 show a two-dimensional bucket, but neither of the two dimensions is related to the traffic class of the packet. Figure 5 shows a generic two dimensional token to be associated with a packet, but neither of the dimensions is related to the traffic class of the packet. Figure 7 is a flowchart of a method which considers the occupancy of the bucket when determining whether to transmit a packet (steps 114 and 134), but the accompanying description at column 9 lines 14-20 clearly explains that this determination is based on whether the bucket indicates that there is sufficient power level and time available to accommodate the two dimensional token of the packet, and makes no reference at all to consideration of the traffic class of the packet. Figures 8a-e show an example of the application of the method of Figure 7 with four example packets and associated tokens, but nowhere considers the traffic class of the packets. Figure 11 is similar to Figure 7 but takes into account the geographic information in the example of three dimensional tokens and bucket, but makes no reference to traffic class. Figure 13 shows an example implementation for three dimensional tokens and buckets, but makes no reference to the traffic class of packets

Column 7 lines 42-53 describes the addition and removal of two dimensional tokens from the two dimensional bucket, but makes no reference to the traffic class of packets. Column 8 lines 21-35 describes the two dimensional token of Figure 5, but makes no mention of the traffic class of the packets, and in fact specifies that the two dimensions of the token are power requirement of transmission of the packet and duration of impact on the system of transmission of the packet. Column 8 line 60 to column 9 line 60 describes the flowchart of Figure 7, but makes no mention of the traffic class of a packet, let alone selectively suppressing transmission

of a packet based on a current token availability level being within a token availability region specifying transmission suppression of packets of the traffic class of the packet. The only consideration used in deciding whether to transmit a packet are whether the two dimensional token associated with a packet fits within the two dimensional bucket of available tokens (column 9 lines 14-20).

In summary, neither Carter nor Patel teach the use of multiple token availability threshold registers to define token availability regions, and determining whether to suppress transmission of a packet based on the current token availability level (i.e. current occupancy of the bucket) being within a token availability region which specifies transmission suppression of packets of the traffic class of the packet.

Claims 2-6 are dependent on claim 1 and include the same limitations discussed above. Claims 7 and 8 comprise the egress rate controller of claim 1 and include the same limitations discussed above. Since the Examiner has not shown where every element of claims 1-8 are taught or suggested by Carter or Patel, either alone or in combination, the Applicant respectfully submits that a *prima facie case* of obviousness has not been established against claims 1-8.

The Examiner has not discussed claims 9, 10, and 12-15. Furthermore claim 9, on which claims 10 and 12-15 are dependent, includes some of the limitations of claim 1, in particular the limitations discussed above. Since the Examiner has not shown where Carter or Patel, either alone or in combination, teach or suggest every element of the claims, the Applicant respectfully submits that a *prima facie case* of obviousness has not been established against claims 9, 10, and 12-15.

Regarding claim 11, the Examiner has stated that the claim recites the same limitations as claim 4 and is distinguished only by its statutory category and is thus rejected on the same basis. The Applicant assumes that this is a clerical error on the part of the Examiner, since claim 11 is dependent on claim 9 which includes limitations not found in claim 4. Since the Examiner has not shown where every element of claim 11, including those of claim 9, are taught or suggested by Carter or Patel either alone or in combination, the Applicant respectfully submits that a *prima facie case* of obviousness has not been established against claim 11.

Claim 16 is directed to a method of effecting egress rate control. The method includes the limitation of suppressing packet transmission of a packet of a particular traffic class when current token availability level of a leaky bucket is between two token availability threshold levels. The Examiner has not shown where this feature of claim 16 is taught by Carter or Patel. As discussed above, neither Carter nor Patel teach consideration of the traffic class of a packet and the current occupancy of a leaky bucket in determining whether to suppress transmission of the packet. Furthermore, neither Carter nor Patel teaches or suggests a leaky bucket having multiple token availability thresholds. The Examiner has indicated (when discussing claim 1) that this element is taught by Patel at Figures 3, 4, and 8a-e. However, these figures (and the rest of Patel) teach two dimensional tokens and buckets. The purpose of the two dimensions is to see whether a two dimensional token of a packet, which reflects the power usage and time requirements of transmitting the packet, fit within the available two dimensional bucket. If the token fits anywhere within the bucket, then there is sufficient power and time to transmit the packet. Patel does not teach multiple availability threshold levels, and a packet is transmitted regardless of the actual occupancy of the bucket as long as the token of the packet fits somewhere within the bucket. This is not the same as determining whether an occupancy is between two thresholds, and only transmitting a packet based on its traffic class and on whether the occupancy of the bucket is between two availability thresholds.

Claims 17-23 are dependent on claim 16 and include the same limitations discussed above. Because the Examiner has not shown where Carter and Patel, either alone or in combination, teach or suggest every element of the claims, the Applicant respectfully submits that a *prima facie case* of obviousness has not been established against claims 16-23.

The Examiner has not discussed claims 24-27. Furthermore, claim 24 includes some of the limitations of claim 16, in particular the limitations discussed above. Claims 25-27 are dependent on claim 24 and include the same limitations discussed above. Since the Examiner has not shown where Carter or Patel, either alone or in combination, teach or suggest every element of the claims, the Applicant respectfully submits that a *prima facie case* of obviousness has not been established against claims 24-27.

Furthermore, the Applicant respectfully submits that the Examiner has not provided reasons why a person of ordinary skill in the art would be motivated to combine the method of Patel with the system of Carter. Throughout the Office Action, the Examiner has merely stated that the motivation would be for "providing a method and system for managing transmission resources in a wireless communications network architecture" (pages 4, 6, 9). This is simply the sentence of the Technical Field of the Invention of Patel (column 1 lines 32-33), and provides no problem which a person of ordinary skill in the art would be trying to solve, and provides no reason why a person of ordinary skill in the art would consider combining Patel and Carter in order to solve such a problem. Since the Examiner has not shown motivation to combine the teachings of Patel and Carter, the Applicant respectfully submits that a *prima facie case* of obviousness has not been established against claims 1-27 with respect to Carter and Patel.

The Examiner has also rejected claims 9-10, 12-15, and 24-27 under 35 U.S.C. §103(a) as being unpatentable over Carter, Patel, and U.S. Patent 6,987,732 issued to Gracon. Gracon teaches a packet scheduler for multi-protocol traffic. A congestion manager considers an instantaneous queue size of a connection to determine whether to drop a packet received on the connection.

Claim 9 is directed to an ingress rate controller which includes a packet acceptance controller. The packet acceptance controller selectively randomly discards packets based on a current token availability level being within a token availability region specifying random packet discard of packets of the traffic class of the packet. This is a feature not taught by Carter, Patel, or Gracon. This feature is discussed in relation to Carter and Patel above with reference to claim 1. The Examiner states that Gracon teaches this feature at column 7 lines 49-53. This passage discusses a random early detection process, in which an average queue size of connections on which packets are arriving is compared with a minimum threshold and a maximum threshold. If the average queue size lies between the minimum threshold and the maximum threshold, then a packet drop probability is calculated, and the packet is randomly dropped based on the calculated packet drop probability (column 7 lines 30-53). While this passage teaches random discard of packets under certain circumstances, nowhere is the traffic class of the packet used as a basis for the determination of whether to perform the random determination. By using multiple threshold levels to define multiple token availability regions, the ingress rate controller of claim 9 uses the

traffic class of a packet and the current occupancy level of the leaky bucket to determine whether to randomly drop a packet. This is not a feature taught by Gracon.

Claims 10 and 12-15 are dependent on claim 9 and include the same limitations. Since the Examiner has not shown where every element of the claims is taught or suggested by Carter, Patel, or Garcon, either alone or in combination, the Applicant respectfully submits that a *prima facie case* of obviousness has not been established against claims 9, 10, and 12-15.

Claim 24 is directed to a method of effecting ingress rate control, and includes the limitation of selectively randomly discarding packets of a particular traffic class when a current token availability level of a leaky bucket tracking packets is between two token availability threshold levels of a plurality of token availability threshold levels. The Examiner has not shown where this feature is taught by Carter, Patel, or Garcon. At page 16 of the Office Action the Examiner appears to address the elements of claim 24, but instead quotes element (d) of claim 9. These are different elements. In addition, the Examiner has cited column 7 line 28 to column 8 line 12 of Gracon as teaching this element. This passage does teach the use of multiple thresholds with which an instantaneous queue size of a connection is compared. Depending on how the queue size compares with the various thresholds, packets of different colors are dropped, some randomly. However, these colors are not based on traffic class, but rather are assigned to a packet based on the compliance of the packet and connection with the scheduling of the policer. Gracon requires a separate and quite complicated algorithm to be performed ahead of time in order to assign a color to a packet (column 4 line 60 to column 7 line 27). While the congestion manager randomly drops some packets based on threshold levels, these threshold levels are defined in terms of the compliance of packet arrival times, and are not based on the traffic class of the packets.

Claims 25-27 are dependent on claim 24 and include the same limitations discussed above. Since the Examiner has not shown where every element of the claims is taught or suggested by Carter, Patel, or Gracon, either alone or in combination, the Applicant respectfully submits that a *prima facie case* of obviousness has not been established against claims 24-27.

Furthermore, the Applicant respectfully submits that the Examiner has not provided reasons why a person of ordinary skill in the art would be motivated to combine the methods of Carter, Patel, and Garcon. Throughout the Office Action, the Examiner has merely stated that

the motivation for combining Carter and Patel would be for "providing a method and system for managing transmission resources in a wireless communications network architecture" (pages 11, 13, 15, 17, 20), and the motivation for combining Carter and Patel with Garcon would be for "providing an apparatus that is programmable to accommodate existing protocols and to anticipate any future protocols, as well as to efficiently schedule packets in a broadband data stream" (pages 12, 16, 18, 21). These are simply the sentence of the Technical Field of the Invention of Patel (column 1 lines 32-33), and the sentences at the end of the Background of the Invention of Garcon (column 2 lines 11-15). These sentences provide no problem which a person of ordinary skill in the art would be trying to solve, and provide no reason why a person of ordinary skill in the art would consider combining Patel and Carter or Patel and Carter and Garcon in order to solve such a problem. Since the Examiner has not shown motivation to combine the teachings of Patel, Carter, and Garcon, the Applicant respectfully submits that a *prima facie case* of obviousness has not been established against claims 9, 10, 12-15, and 24-27.

In view of the foregoing, it is believed that the claims at present on file are in condition for allowance. Reconsideration and action to this end is respectfully requested.

Respectfully submitted,

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CERTIFICATE OF TRANSMISSION

I hereby certify that this correspondence and documents identified as being enclosed herewith are being deposited with the Office EFS system on **October 9, 2007.**

Ann Simonini